

Claims

1 1. A lithography system comprising:
2 a plurality of lens elements;
3 the plurality of lens elements having a first lens element adapted to face a source
4 of radiation, and having a final lens element comprising a material with an index of
5 refraction greater than 1, and having a surface adapted to be pressed against the sample in
6 order to form a depression at the surface of the sample facing the final lens element; and
7 a stage to support said sample in contact with the surface of the final lens element.

1 2. The lithography system of claim 1, wherein the material of said final lens element
2 comprises one of silicon dioxide, calcium fluoride, aluminum oxide, yttrium fluoride,
3 lanthanum fluoride, strontium fluoride.

1 3. The lithography system of claim 1, wherein said plurality of lens elements
2 projects radiation having a wavelength of about 193nm to the sample.

1 4. The lithography system of claim 1, wherein said plurality of lens elements
2 projects radiation having a wavelength of about 157nm to the sample.

1 5. The lithography system of claim 1, including a mask between the source of
2 radiation and said plurality of lens elements, and said plurality of lens elements
3 demagnifies an object on the mask by a factor greater than 4 at an image plane on or near
4 said sample.

1 6. The lithography system of claim 1, including a mask between the source of
2 radiation and said plurality of lens elements, and said plurality of lens elements projects
3 an image of an object on the mask at an image plane on or near the surface of the final
4 lens.

1 7. The lithography system of claim 1, wherein said sample has a layer adapted to be
2 developed in response to radiation projected by the plurality of lens elements.

1 8. The lithography system of claim 7, wherein said sample has a soft layer coated on
2 top of said layer adapted to be developed in response to radiation projected by the
3 plurality of lens elements.

1 9. The lithography system of claim 1, wherein a material adapted to be developed in
2 response to radiation projected by the plurality of lens elements is dispensed on top of the
3 sample before the final lens element is pressed against the sample.

1 10. The lithography system of claim 1, wherein the final lens element comprises a
2 removable slab of said material.

1 11. A lithography system comprising:
2 a projection lens for imaging an object on a mask onto a sample, one side of the
3 projection lens adapted to be pressed against the sample in order to form a depression at
4 the surface of the sample facing the projection lens and an other side of the projection
5 lens adapted to be placed in contact or in close proximity with the mask; and
6 a stage to support said sample in contact with the projection lens.

1 12. The lithography system of claim 11, wherein the other side of the projection lens
2 placed in contact or in close proximity with the mask comprises a removable slab of
3 material.

1 13. The lithography system of claim 11, wherein a material of a lens element of said
2 projection lens adapted to be placed in contact or in close proximity with the mask,
3 comprises a material including one of silicon dioxide, calcium fluoride, aluminum oxide,
4 yttrium fluoride, lanthanum fluoride, strontium fluoride.

1 14. The lithography system of claim 11, wherein said projection lens projects
2 radiation having a wavelength of about 193nm from the mask to the sample.

1 15. The lithography system of claim 11, wherein said projection lens projects
2 radiation having a wavelength of about 157nm from the mask to the sample.

1 16. The lithography system of claim 11, wherein said projection lens demagnifies an
2 image on the mask by a factor greater than 4 at an image plane on or near said sample.

1 17. The lithography system of claim 11, wherein said projection lens, includes a lens
2 element having a surface adapted to be pressed against the sample in order to form a
3 depression at the surface of the sample facing the lens element, and the projection lens
4 projects an image of a mask at an image plane on or near said surface of said lens
5 element.

1 18. The lithography system of claim 11, wherein said projection lens, includes a lens
2 element having a surface adapted to be pressed against the sample in order to form a
3 depression at the surface of the sample facing the lens, said lens element comprises a
4 removable slab.

1 19. A method for manufacturing integrated circuits, comprising:
2 providing a sample having a layer adapted to be developed in response to
3 radiation;
4 providing a layout object to be projected on said layer;
5 pressing said layer on said sample against a lens element of a projection lens in
6 order to form a depression at the surface of the layer facing the lens element, wherein
7 said lens element comprises a material having an index of refraction for said radiation
8 greater than 1; and
9 imaging the object on said layer through said projection lens.

1 20. The method of claim 19, including imaging the object at an image plane near a
2 top surface of said layer.

1 21. The method of claim 19, where a soft layer is coated on top of said layer adapted
2 to be developed in response to radiation.

1 22. The method of claim 19, including preventing adhesion of said lens element to
2 said layer.

1 23. The method of claim 19, including cleaning the lens element after exposure.

1 24. The method of claim 19, including placing a mask including said layout object in
2 contact or close proximity with another lens element of a projection lens, wherein said
3 other lens element comprises a material having an index of refraction for said radiation
4 greater than 1.

1 25. The method of claim 19, including laying out a layout pattern on a mask including
2 the layout object to be imaged on said layer, said laying out including applying proximity
3 correction using a lithography model comprising, for an incident material different than
4 air characterized by its refractive index and absorption coefficient, calculating fields in
5 said layer, accounting for the incident material refractive index and absorption
6 coefficient, performed using thin film optics or by solving Maxwell equations

1 26. The method of claim 19, including laying out a layout pattern on a mask including
2 the layout object to be imaged on said layer, the layout pattern comprising an alternating
3 aperture phase-shifting mask layout, said laying out including applying proximity
4 correction using a lithography model comprising, for an incident material different than
5 air characterized by its refractive index and absorption coefficient, calculating fields in
6 said layer, accounting for the incident material refractive index and absorption
7 coefficient, performed using thin film optics or by solving Maxwell equations.

1 27. The method of claim 19, including laying out a layout pattern on a mask including
 2 the layout object to be imaged on said layer, wherein said imaging the object on said
 3 layer through said projection lens, includes applying an off-axis setting for the projection
 4 lens, the off-axis setting obtained using a lithography model comprising, for an incident
 5 material different than air characterized by its refractive index and absorption coefficient,
 6 calculating fields in the resist, accounting for the incident material refractive index and
 7 absorption coefficient, performed using thin film optics or by solving Maxwell equations.

1 28. The method of claim 19, including laying out a layout pattern on a mask including
 2 the layout object to be imaged on said layer, the layout pattern comprising an assist
 3 feature having a size and a distance from a corresponding main feature, said laying out
 4 including determining said size and distance using a lithography model comprising, for
 5 an incident material different than air characterized by its refractive index and absorption
 6 coefficient, calculating fields in said layer, accounting for the incident material refractive
 7 index and absorption coefficient, performed using thin film optics or by solving Maxwell
 8 equations.

1 29. The method of claim 19, including laying out a layout pattern on a mask including
 2 the layout object to be imaged on said layer, the layout pattern comprising an attenuated
 3 phase-shifting mask having sizing parameters, said laying out including determining said
 4 sizing parameters using a lithography model comprising, for an incident material
 5 different than air characterized by its refractive index and absorption coefficient,
 6 calculating fields in said layer, accounting for the incident material refractive index and
 7 absorption coefficient, performed using thin film optics or by solving Maxwell equations.

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1 30. The method of claim 19, wherein the sample comprises a wafer including a
2 plurality of materials forming a wafer stack, and including laying out a layout pattern on
3 a mask including the layout object to be imaged on said layer, said laying out including
4 applying proximity correction using a lithography model comprising, for an incident
5 material different than air characterized by its refractive index and absorption coefficient,
6 dividing the refractive indices and absorption coefficients of all the materials in the wafer
7 stack by the refractive index of the incident material.